AGRICULTURE

Project Fact Sheet

Enhancement of Biobased Products from Sorghum Grain with Optimized Production and Composition Using Advanced Genomics

Benefits

- Provides new feedstock for biobased products
- Requires less water than other plants of similar yield
- Utilizes marginal lands in an effective manner
- Improves rural economies
- Optimized sorghum is more efficiently processed
- Potential 2020 target market is 2 billion gallons of ethanol per year
- Projected 2020 process energy savings due to improved feedstock qualities are 13.4 trillion Btu per year

Applications

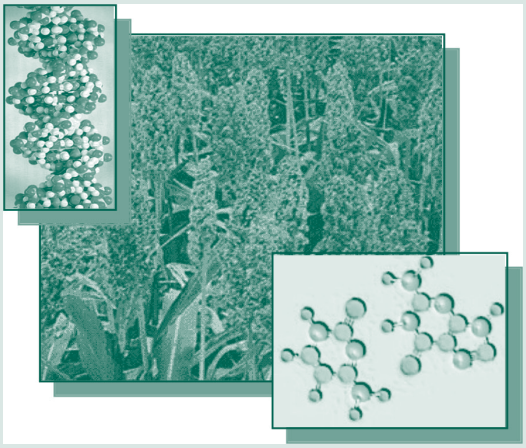
The success of this project will not only be measured in the emergence of sorghum as a viable renewable feedstock, but also in the knowledge base developed. The novel genetic tools and results will be applicable to other crops including corn stover, as will the approach to market and economic development.

Hardy Sorghum will be Optimized for Use as Biobased Product Feedstock

Sorghum was first domesticated for food and feed uses about 5000 years ago, and has become the third most important cereal crop grown in the U.S. The sorghum crop is well recognized as being relatively stress tolerant, and as having a low requirement for water per unit yield. The versatility of sorghum has led to a broad range of uses in several markets including feedstuffs, snack foods, and malted beverages. It has also been used in wallboard, by the housing industry, and 10-12% of domestic grain sorghum is converted to ethanol, for use as a biofuel. However, neither the grain composition nor the conversion processes to ethanol have received much attention in terms of optimization for these particular uses. No research has yet been done on the use of sorghum to provide a glucose stream for conversion to biobased chemical molecules. With a relatively high yield, drought tolerance, and favorable production characteristics for large areas of the country, sorghum is an excellent candidate crop for biobased products. In addition, enhanced sorghum will offer farmers a chance to reduce production costs while producing value-added products such as chemicals and materials that will contribute to the rural economy.

This project will integrate a team of multi-disciplinary researchers to identify and sequence the genes of sorghum, discover the links between specific genes and the composition of grain, use plant breeding to improve the grain composition, and identify a potential portfolio of processed output products. The main desirable traits include yield per unit resource used, increased starch content, and enhanced starch types that will enable more efficient processing of sorghum to biobased products as well as acceptable agronomic traits and drought tolerance for improved economics of production. Processing technologies will be selected to optimize the use of enhanced sorghum grain. Expected output products will include ethanol, lactate, succinate, acetate, citrate, and uses for the remaining fiber and protein will also be investigated.

Figure 1. Sorghum Crop



Project Description

Goal: To enable more efficient production of ethanol and bioproducts from sorghum grain.

SolviGen will work with industry leaders to determine the critical traits, both positive and negative, for efficient conversion of sorghum to biobased products. These will include starch type, starch content, fiber content, and protein content. Concurrently, Orion Genomics will utilize a new, proprietary sequencing technique to identify and sequence all of the sorghum genes. Functional genomics will then be used to identify the genes that regulate the traits critical to sorghum processing. This information will be used, along with elite germplasm, in the NC+ Hybrids breeding program that will combine enhanced starch traits with high yield, drought tolerance, and acceptable agronomic traits.

The enhanced sorghum hybrids will be lab-scale tested for their performance in milling processes, and for use as a glucose stream. The results will be used by the integrated team for additional "design" improvements in the genetic makeup, and be cycled back through the breeding program. When appropriate hybrids are produced, they will be evaluated at pilot-scale levels. Evaluations will include sorghum grain to ethanol, and sorghum starch to glucose as a precursor for products including lactate, succinate, acetate, and citrate. The optimum portfolio of outputs will be determined from market feasibility studies across particular production regions. The remaining co-products from processing the grain, such as protein and fiber, will be evaluated as feedstock for products such as polyols and polymers.

Assessments will be conducted to determine the best locations for sorghum production and processing facilities based on a combination of agronomic, technical, market, and business factors. Preferences will be given to systems that make a significant contribution to rural development.

Progress and Milestones

- Unveil the sorghum gene set through the application of GeneThresher™ gene enrichment technology
- Characterization of starch content/yield characteristics in sorghum germplasm collection
- Discovery and characterization of candidate genes for program target traits
- Expression of new traits in elite germplasm
- Improved processing characteristics of new sorghum lines
- Evaluation of end-product mix
- Identification of relevant processing technologies
- Scenarios for production and processing infrastructures.

GeneThresher™ is a trademark of Orion Genomics, LLC.

Project Partners

NC+ Hybrids
Colwich, KS

Orion Genomics, LLC
St. Louis, MO

SolviGen LLC
Chesterfield, MO

With support from:

Cold Spring Harbor Lab
Cold Spring Harbor, NY

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